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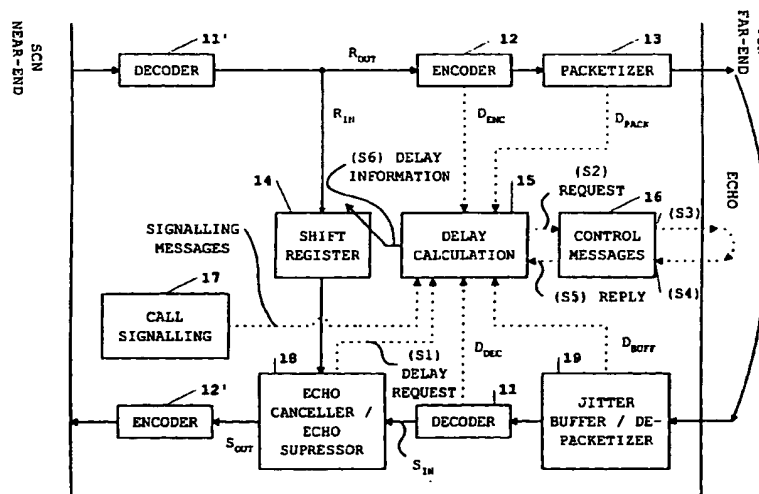
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(54) Title: A DELAY MEASUREMENT SYSTEM IN A PACKET NETWORK



(57) Abstract: The present invention proposes a method of providing information of the echo path of a speech connection in a Packet Data Network, said method comprising the steps of requesting delay information by means for triggering echo removal, said delay information being obtained by signaling a non-speech measurement data unit to said Packet Data Network by an echo estimation means, and measuring the delay of the echo of said measurement data unit by said echo estimation means; replying the echo delay of said measurement data unit from said echo estimation means; generating delay information including at least said echo delay of said measurement data unit; and adjusting a shift register being related to an echo removing device by the use of said delay information such that the performance of said echo removing device is optimized in view of its echo removing capability.



A DELAY MEASUREMENT SYSTEM IN A PACKET NETWORK

Field of the invention

5 The present invention relates to a method of providing information of the echo path of a speech communication in a Packet Data Network, and a communication network and a gateway apparatus using the same method.

10 Related background art

Networks being based on packet switching as a network with an asynchronous transfer mode (ATM) or a network using the internet protocol (IP) have inconsistent delay
15 characteristics. Typical events as routing, a possible congestion due to the presence of variable length buffers and other protocol handling procedures may easily cause a quite high total end-to-end delay and/or a delay variation.

20

Some applications like an echo cancellation or an echo suppression need to know the exact round-trip delay for an appropriate echo removing performance. An echo canceller has a limited delay matching capability which
25 nowadays is typically in the range of 0 to 150 ms. An echo canceller can handle the delay variation of a packet switched network easily in this range, but the total round-trip delay may become a problem, since the delays may go far beyond this capability. For example, in
30 networks using the internet protocol (IP) the induced delay may be in the range of 0 - 1000 ms.

Particularly, this problem may arise if a packet network connection is in the echo path of an echo removing device
35 such as an echo canceller or echo suppressor. Reference

is made to ETSI document TR 101 307, wherein such scenarios are described, and to ETSI document EG 201 050, wherein examples for echo suppressors and echo cancellers are given. Moreover, a specification describing the
5 recommendations for internet protocol (IP) terminals regarding acoustic echo controllers is included in the document ITU-T G.167, and a specification describing the recommendations for echo cancellers for Voice over Internet Protocol (VoIP) gateways is included in the
10 document ITU-T G.168.

Such a configuration is needed if an echo removing device at the far-end is missing or if it is malfunctioning in such a way that some echo is leaked through to the
15 near-end. In a native terminal using the internet protocol (IP) in which a high quality echo removing device might be missing, most probably far-end echo is not cancelled sufficiently. Therefore, it is required that the near-end obtains a far-end echo cancellation
20 over the internet protocol (IP) network.

In echo cancellers, the round-trip delay is typically obtained from the estimated echo impulse response which is generated by the adaptive filter of the echo
25 canceller. This delay information is usually used for adjusting the timing of the non-linear processor of the echo canceller. However, if the round-trip delay exceeds the length of the adaptive filter, the echo estimation cannot be modeled, and therefore, the echo is not
30 cancelled. To overcome longer delays, the length of an adaptive filter could be increased. However, a longer filter results in increased processing and memory requirements. Furthermore, the convergence speed is decreased, and the residual echo level and noise floor
35 after the echo estimation and echo subtraction is higher

with longer adaptive filters, i.e. the performance is degraded.

An approach to avoid long adaptive filters is a windowed
5 adaptive filter, in which a shift register precedes the
adaptive filter. Therein, the length of the shift
register could be adjusted according to the round-trip
delay such that the peak of the echo impulse response
hits somewhere onto the middle of the adaptive filter. By
10 this approach very long round-trip delays can be handled.

In order to cover the whole delay range, which is a
requirement in packet switched networks, a delay search
method has to be applied. Typically, the delay can be
15 estimated by a cross-correlation algorithm between sent
and received signals. For long delays, however, this
requires a lot of memory and processing power. Moreover,
it takes some time to find the actual delay, and thus,
echo might be heard at the beginning of a call.

20 Apart from that, an echo suppressor does not contain any
adaptive filter, and therefore, there are no inherent
means to estimate the round-trip delay. However, an echo
suppressor needs to know the round-trip delay in order to
25 adjust its switching function to the proper phase
according to the round-trip delay. With short delays,
like in terminals, a pre-defined fixed timing can be
used, whereas longer delays require a delay search method
similar to that mentioned above, i.e. if an echo
30 suppressor is used in a packet network it encounters the
same problems as a windowed echo canceller.

One known possibility to measure the round-trip delay is
that the delay-dependent application, e.g. an echo
35 canceller or suppressor as mentioned herein, measures the

delay itself by the use of the echo path impulse response, a cross correlation, etc. from the raw data available. That is, the delay is calculated from the speech sent and the echoed speech heard, i.e. from voice
5 samples.

Unfortunately, it requires too much memory and/or processing power to thereby obtain the desired delay range. Further, a longer time is needed to find the delay
10 value in longer round-trip delays.

Hence, there is a need for an alternative estimation of the echo round-trip delay for a windowed echo canceller and an echo suppressor, if a packet network connection is
15 present in the echo path.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to
20 provide a method of providing information of the echo path of a speech connection in a Packet Data Network which is free from the above drawbacks.

According to the present invention, this object is
25 achieved by a method of providing information of the echo path of a speech connection in a Packet Data Network, said method comprising the steps of requesting delay information by means for triggering echo removal, said delay information being obtained by signaling a non-
30 speech measurement data unit to said Packet Data Network by an echo estimation means, and measuring the delay of the echo of said measurement data unit by said echo estimation means; replying the echo delay of said measurement data unit from said echo estimation means;
35 generating delay information including at least said echo

delay of said measurement data unit; and adjusting a shift register being related to an echo removing device by the use of said delay information such that the performance of said echo removing device is optimized in
5 view of its echo removing capability.

This method according to the present invention can be very advantageously modified in that said means for triggering echo removal are related to a delay
10 calculating device by which said delay calculating device requests from said echo estimation means to perform said signaling of a measurement data unit; and said echo delay of said measurement data unit is replied to said delay calculation device which calculates an estimation of a
15 total round-trip delay of said echo path of a speech, which estimation corresponds to said generated delay information, and said calculation is based on said received echo delay of said measurement data unit and other delays which are provided to said delay calculation
20 device.

Other advantageous modifications reside in that said delay calculation device monitors a call signaling device and said delay information request is triggered when a
25 call is established by a call setup signaling of said call signaling device; in that said delay request is triggered during the signaling of a call establishment after a voice channel is activated and a delay is replied before an alerting is signaled; in that after said delay
30 information is replied, said delay calculation is performed, and said shift register is adjusted, it is checked whether an echo path model being present in said delay calculation device is reliable, and if not, said echo removing device calls an echo request procedure
35 again; or in that after said checking of reliability, it

is checked whether said call is released, and if not, said checking of reliability is repeated.

Furthermore, according to the present invention, the
5 object can be solved by a communication network system comprising a Switched Circuit Network, a Packet Data Network, a gateway apparatus of said Switched Circuit Network on the interface to the Packet Data Network, wherein said gateway apparatus comprises means for
10 providing delay information of an echo path of a speech connection from said Switched Circuit Network to said Packet Data Network by using control messages of said Packet Data Network, and a gateway apparatus of said Packet Data Network on the interface to the Switched
15 Circuit Network which supports the functions of said gateway apparatus of said Switched Circuit Network.

Moreover, to attain a solution of the present object, according to the present invention there is provided a
20 gateway apparatus comprising means for providing an interface functionality between a Switched Circuit Network and a Packet Data Network; echo estimation means for providing delay information of the echo of a speech connection; a delay calculation device for calculating an
25 estimation of a total round-trip delay of an echo path of said speech connection; a shift register getting an adjustment input from said delay calculation device; and an echo removing device, the performance of which is optimized in view of its echo removing capability by a
30 respective input of said shift register.

According to the present invention, a shorter delay window can be used for the delay search algorithm as compared to the prior art, which saves memory and
35 processing power resources in the echo removing device.

Moreover, the delay is found faster by the delay search algorithm. Additionally, the convergence time is faster as the external delay information can be provided for the echo removing device before the actual speech
5 conversation.

According to the present invention, the delay-dependent application uses some specific signaling-like measurement mechanism, i.e. a non-speech measurement data unit like a
10 control message is sent. Examples for such a mechanism are a pinging procedure by the use of the Internet Control Message Protocol ICMP, a procuring of a Real-Time Control Protocol RTCP report, a procuring of an Asynchronous Transfer Mode Operation And Maintenance ATM
15 OAM report, a proprietary signaling procedure or the like.

Of course, the kind of the mechanism used depends on what applications are or can be supported by the far-end
20 application. However, a pinging procedure using the Internet Control Message Protocol ICMP would be already supported by devices using the Internet Protocol IP, i.e. it is a mandatory feature. Further, the Real-Time Control Protocol is included in the protocol according to
25 document ITU-T H.323: "Packet based multimedia communications systems". It is noted that present terminals of the internet fulfill the requirements of this specification (H.323).

30 One principal illustration of the present invention is depicted in Fig. 6. Therein, reference numerals 611 and 612 denote terminals of a Switched Circuit Network SCN for transmitting input speech data. Presently, such speech data is typically transmitted with a transfer rate

of 64 kbps to a mobile services switching center MSC and fixed switching center FSC 613, respectively.

Further, reference numeral 614 denotes a gateway
5 apparatus including an echo removing device 615 such as an echo canceller EC or an echo suppressor or the like. The gateway apparatus 614 serves for the connection with other network communication entities while the gateway
10 apparatus 614 itself is connected to the mobile services switching center MSC and fixed switching center FSC 613, respectively.

Particularly, as in the case of the present invention, the gateway apparatus 614 can serve for the connection
15 with a Packet Data Network PDN in which, in turn, a gateway apparatus 621 is present for this connection with the gateway apparatus 614. The gateway apparatus 621 may be substantially equal to the gateway apparatus 614 or anyhow different within its usual range of functionality.
20 The echo removing mechanism of the far-end gateway apparatus 621 might be malfunctioning in such a way that echo leaks through to the near-end. Therefore, the echo removing mechanism 615 at the near-end should remove this echo.

25 According to the present invention, there are means 616, 623 provided which exchange a non-speech measurement data unit by using one of the above mentioned control message procedures as the pinging procedure within the Internet
30 Control Message Protocol ICMP, the Real-Time Control Protocol or a proprietary signaling procedure, or the like.

In Fig. 6 there is depicted an example of a Voice over
35 Internet Protocol (VoIP) network which nevertheless

suites for generally describing the present invention, since those who are skilled in the art are fully aware of generalizing this example within the already above indicated range of respective applications.

5
In detail, echo cancellers EC or echo suppressors are located inside VoIP gateways GW. The gateway GW of the Switched Circuit Network SCN transmits respective speech data to the Gateway GW of the Packet Data Network by
10 using the Internet Protocol IP. Presently, this is for example done with a transfer rate of 8 kbps. However, the interaction between these echo cancellers EC or echo suppressors is established by means of the above mentioned signaling mechanisms. That is, there are means
15 616, 623 present which communicate with each other by using one of the above protocols and procedures, respectively. By this communication, a measurement data unit is exchanged by the use of which the current network delay is told to the echo removing algorithm of the echo
20 canceller EC or echo suppressor.

Apart from that, it is also possible to insert proprietary timing information to the data stream itself. However, that is not applicable with commercial Internet
25 Protocol clients as indicated in Fig. 6 by the Internet Phone 624.

The delay measurement system in a packet network according to the present invention is especially
30 applicable for enhancing an echo cancellers or echo suppressors working capabilities. According to the present invention, there is provided a better speech quality, a faster convergence and a more efficient implementation of an echo canceller or an echo
35 suppressor.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described herein below in
5 detail by way of example with reference to the
accompanying drawing, in which

Fig. 1 shows an embodiment of the gateway apparatus
according to the present invention;

10

Fig. 2 illustrates an example of how an embodiment of the
method according to the present invention could be mapped
into the Internet Protocol (IP) hierarchy;

15 Fig. 3 illustrates another example of how an embodiment
of the method according to the present invention could be
mapped into the Internet Protocol (IP) hierarchy;

Fig. 4 shows a signaling sequence illustrating a suitable
20 triggering point for the method according to the present
invention in a call setup procedure.

Fig. 5 shows a flow chart illustrating an embodiment of
the method according to the present invention; and

25

Fig. 6 shows the example of a Voice over Internet (VoIP)
network with additional delay measurement mechanisms for
illustrating the present invention.

30 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows a detailed block diagram of an echo removing
device 18 such as an echo canceller or an echo suppressor
being integrated into a gateway apparatus GW between a
35 Switched Circuit Network SCN and a Packet Data Network

PDN. Such a gateway apparatus typically comprises speech decoding means 11, 11', speech encoding means 12, 12', packetizing means 13, receive jitter buffer means 19, and an echo canceller. Usually, an echo canceller for the
5 cancellation of the echo of the SCN echo is a mandatory part of a gateway. However, it will not affect the echo removing device of the present invention which removes the echo of the PDN. Therefore, the echo removing device for the removal of the echo of the SCN is omitted in fig.
10 1.

Also the speech decoding means 11, 11' and the speech encoding means 12, 12' are not essential for carrying out the present invention. However, they are to be
15 considered, since these means typically produce more delay into a system. This delay would be negligible if a codec according to document ITU-T G.711 is used in the gateway. In this case, encoding means a conversion from linear to a-law (μ -law), and decoding means a conversion
20 from a-law (μ -law) to linear. For the a-law and μ -law encoding, reference is made to e.g. document ITU-T G.711. In contrast thereto, if low bit-rate codecs are used, the throughput delay of the gateway apparatus GW caused by speech coding is in a range of 5 to 50 ms.

25 The essential blocks of the gateway apparatus according to the present invention which are depicted in fig. 1 are echo estimation means 16, a delay calculation device 15, a shift register 14, and an echo removing device 18. As
30 mentioned above, the echo estimation means 16 preferably use control messages of a standard or proprietary protocol in a packet network. Standard protocols can be e.g. Internet Control Message Protocol (ICMP), Real-Time Control Protocol (RTCP) or ATM Operation And Maintenance
35 (OAM) messages. According to the present invention,

control messages are used to estimate round-trip delays of data packets sent to a far-end gateway GW, a client or the like and echoed back to the gateway GW.

5 It is noted, however, that in this delay model additional delays caused by speech coding, speech packetizing and receive buffering are not taken into account so far. Therefore, a delay calculation device is needed for the calculation of a comprehensive estimation of the real
10 round-trip delay between the R_{IN} and S_{IN} ports of the echo removing device 18 and shift register 14, respectively.

One possibility to calculate an estimation of the real round-trip delay is as follows:

15

$$D_{tot} = D_{cont_mes} + 2 \cdot (D_{enc} + D_{dec}) + D_{pac} + D_{buff}$$

Where

D_{cont_mes} = delay estimation indicated by the
20 control message block (echo estimation means) 16
 D_{enc} = encoding delay
 D_{dec} = decoding delay
 D_{pac} = speech packetizing delay
25 D_{buff} = delay due to jitter buffer

It is noted that the encoding and decoding delays have to be multiplied by two because both the gateway GW and far-end application comprises a similar coding method.
30 The packetizing and receive buffering delays of the far-end application might not be known. Therefore, it is safe to include only the delays of the own gateway apparatus GW. Therein, a delay estimation algorithm (e.g. adaptive filter, cross-correlation) within the echo
35 removing device 18 should cope with packetizing, receive

buffering, AD/DA conversions and local loop delays of the far-end application.

Hence, according to a method according to the present invention of providing information of the echo path of a speech connection in a Packet Data Network PDN starts in that a respective delay information is requested. This request (S1, S2) corresponding to a triggering of an echo removal may be asked by the echo removing device 18 itself or by the delay calculation device 15.

Anyway, the delay information is obtained by signaling (S3) a non-speech measurement data unit to said Packet Data Network PDN by the echo estimation means 16. The non-speech measurement data unit is preferably one of those discussed above. Accordingly, in the following, the non-speech measurement data unit will be denoted as control message(s). The time between the sending (S3) of a control message and receiving (S4) its echo is measured by the echo estimation means 16. Obviously, this corresponds substantially to the delay generated by the Packet Data Network.

Next, this delay information of the echo delay is replied from said echo estimation means 16 (S5). Preferably, the information is delivered to the delay calculation device 15 to obtain full advantages in that a total round-trip delay of the echo path of a packet switched connection is calculated on the basis of the received echo delay of the control messages. After the calculation of the round-trip delay estimation, the length of the shift register 14 can be adjusted accordingly.

The shift register 14 is related to the echo removing device 18 and the adjustment is executed by the use of

the requested delay information such that the performance of said echo removing device 18 is optimized in view of its echo removing capability (S6). If the echo removing device 18 is an echo canceller, the shift register 14 is
5 adjusted such that the returning echo hits on the range of an adaptive filter of this echo canceller, thereby having the performance of the echo canceller optimized in view of its echo removing capability. Whereas, if the echo removing device 18 is an echo suppressor, the shift
10 register 14 is adjusted such that the timing of a switching function of this echo suppressor is appropriate for a round-trip delay of the speech connection, thereby having the performance of the echo suppressor optimized in view of its echo removing capability.

15

In order to take the delay variations in a PDN into account, it might be necessary to repeat the delay calculation several times. Thus, the estimated delay can be somewhere between the average and maximum delay value.

20

For this and other reasons, the triggering for the above described method should suitably be possible for both, the delay calculation device 15 and the echo removing device 18. In the following, this will be explained in
25 more detail.

A call signaling device as shown in fig. 1 is responsible for e.g. call establishment in a gateway apparatus GW. The delay calculation device 15 monitors a possible call
30 setup signaling. Whenever the delay calculation device 15 detects a call establishment, it sends a request to the delay estimation means 16 to trigger the delay estimation. A suitable time instant for the request is shown in fig. 4, where a signaling sequence of a call
35 setup procedure is illustrated having the signaling of

the delay measurement included. It is noted that the triggering point for the delay request could in principle be also elsewhere during the call establishment. However, the earlier the point is, the better it is, as there is
5 more time to find a delay estimation before the actual speech conversation (after the connect message shown in fig. 4). The call setup procedure presented in fig. 4 corresponds to the specifications ITU-T H.225 and Q.931, and these are to be considered as an example.

10

Specifically, a setup signaling sequence is transmitted from a Switched Circuit Network SCN over a gateway apparatus GW to a Packet Data Network PDN. The Packet Data Network PDN responds with a call proceedings
15 signaling sequence over the gateway apparatus GW to the Switched Circuit Network SCN. Accordingly, a voice channel is then activated between the gateway apparatus GW and the Packet Data Network PDN. As mentioned above, according to an embodiment of the present invention, at
20 this point a delay request could be signaled from the gateway apparatus GW to the Packet Data Network PDN which, in turn, signals a delay reply back to the gateway apparatus. This request-reply pair of signaling sequences follows to what is set out here being in accordance with
25 the present invention. Having the delay determined at this point, the following signaling sequences from the Packet Data Network PDN over the gateway apparatus GW to the Switched Circuit Network SCN of alerting and subsequently connecting might already benefit therefrom.
30 Anyway, when the end to end session of the speech connection between the two networks SCN and PDN starts, the delay should have been determined at the latest if no echo shall be heard in the call. However, there is no limitation to that, i.e. if the delay is not determined
35 up to that point, but during the transmission of speech,

echo will first be heard but will disappear according to a respective performing of the method according to the present invention.

- 5 As the delay can change quite a lot during a call in a PDN, a method to detect these variations is required for the echo removing device 18 (echo canceller/echo suppressor). The delay variations can be handled by the echo removing device 18 if the variations are within the
- 10 length of internal delay estimation algorithms (e.g. adaptive filter or cross-correlation). However, if the variations exceed the capacity of the echo removing device 18, the echo path model is totally lost and the echo is not removed. Therefore, it should be possible
- 15 that the echo removing device can also trigger the delay request procedure according to the present invention, if the echo path model is lost or residual echo level is constantly high.
- 20 Fig. 5 shows a flow chart illustrating how the delay request procedure is called during the call establishment and during the call. As mentioned above, the delay request shall be made in a step S53, in this case preferably by the echo removing device 18 itself, after
- 25 the preceding steps S51 of establishing the call and S52 of activating a voice channel were executed. The subsequent steps S54 to S56 follow according to what has been already described above in this connection. However, after the adjustment of the shift register 14, it is
- 30 checked in a step S57 whether the echo path model is reliable or not. In case of "no", the procedure returns to step S53 and the delay is requested again. In case of "yes", the procedure proceeds further to step S58 wherein it is questioned whether the call is released or not.
- 35 Evidently, in case it is, the procedure is ended.

Consequently, if the call is not released, the procedure returns to step S57.

According to the above, the use of control messages
5 within the Internet Protocol is the preferred embodiment of the present invention. Hence, figures 2 and 3 show two examples of how the above described methods can be mapped into the Internet Protocol hierarchy. It is noted that the depicted hierarchy follows the conventional OSI 7
10 layer model. Full description thereof can be found in respective standard textbooks, additional reference is made to ETSI document TR 102 100.

In fig. 2 is shown the example if a 'Ping' procedure is
15 utilized as the control messages. Such a Ping procedure is a globally used application within TCP/IP protocol stacks (TCP - Transfer Control Protocol) to estimate round-trip delay around to a far-end host. Therefore, practically every device connected to the IP understands
20 it. A Ping procedure typically uses an echo request of the ICMP and echo reply messages of the ICMP to estimate round-trip delays. In this example the delay calculation device calls the Ping application of the TCP/IP to estimate the round-trip delay. Any voice data is
25 transferred in parallel thereto within UDP/IP packets (UDP - user datagram protocol). Another choice instead of using Ping of TCP/IP stack is that the delay calculation
15 generates itself ICMP echo request and receives ICMP echo reply messages.

30

In fig. 3 is shown the example if the Real-Time Protocol RTP and the Real-Time Control Protocol RTCP are used for voice and control data, respectively. The round-trip delay estimation can be calculated from the sender and
35 receiver reports of the RTCP.

As is described above, the present invention proposes a method of providing information of the echo path of a speech connection in a Packet Data Network (see fig. 1),
5 said method comprising the steps of requesting (S1, S2) delay information by means 18, 15 for triggering echo removal, said delay information being obtained by signaling (S3) a non-speech measurement data unit to said Packet Data Network PDN by an echo estimation means 16,
10 and measuring (S4) the delay of the echo of said measurement data unit by said echo estimation means 16; replying (S5) the echo delay of said measurement data unit from said echo estimation means 16; generating 15 delay information including at least said echo delay of said measurement data unit; and adjusting (S6) a shift register 14 being related to an echo removing device 18 by the use of said delay information such that the performance of said echo removing device 18 is optimized in view of its echo removing capability.

20

It should be understood that the above description and accompanying figures are only intended to illustrate the present invention by way of example only. The preferred embodiments of the present invention may thus vary within
25 the scope of the attached claims.

Claims

1. A method of providing information of the echo path of a speech connection in a Packet Data Network, said method comprising the steps of
- requesting (S1, S2) delay information by means (18, 15) for triggering echo removal, said delay information being obtained by
- signaling (S3) a non-speech measurement data unit to said Packet Data Network (PDN) by an echo estimation means (16), and
- measuring (S4) the delay of the echo of said measurement data unit by said echo estimation means (16);
- replying (S5) the echo delay of said measurement data unit from said echo estimation means (16);
- generating (15) delay information including at least said echo delay of said measurement data unit; and
- adjusting (S6) a shift register (14) being related to an echo removing device (18) by the use of said delay information such that the performance of said echo removing device (18) is optimized in view of its echo removing capability.
2. A method according to claim 1, wherein
- said means for triggering echo removal are related to a delay calculating device (15) by which said delay calculating device (15) requests from said echo estimation means (16) to perform said signaling (S3) of a measurement data unit; and
- said echo delay of said measurement data unit is replied (S5) to said delay calculation device (15) which calculates an estimation of a total round-trip delay of said echo path of a speech, which estimation corresponds to said generated delay information, and said calculation is based on said received echo delay of said measurement

data unit and other delays which are provided (D_{ENC} , D_{DEC} , D_{PACK} , D_{BUFF}) to said delay calculation device.

3. A method according to claim 2, wherein said delay
5 calculation device (15) calculates said estimation of a total round-trip delay D_{tot} on the basis of the following formula:

$$D_{tot} = D_{cont_mes} + 2 \cdot (D_{enc} + D_{dec}) + D_{pac} + D_{buf}$$

10

wherein D_{cont_mes} denotes the delay measured by said echo estimation means (16), D_{enc} denotes the delay caused by encoding means (12), D_{dec} denotes the delay caused by decoding means (11), D_{pac} denotes the delay caused by
15 speech packetizing means (13) and D_{buff} denotes the delay due to jitter buffer means (19).

4. A method according to claim 1, wherein if said echo removing device (18) is an echo canceller, said shift
20 register (14) is adjusted such that the returning echo hits on the range of an adaptive filter of said echo canceller, thereby having the performance of said echo canceller optimized in view of its echo removing capability.

25

5. A method according to claim 1, wherein if said echo removing device (18) is an echo suppressor, said shift register (14) is adjusted such that the timing of a switching function of said echo suppressor is appropriate
30 for a round-trip delay of said speech connection, thereby having the performance of said echo suppressor optimized in view of its echo removing capability.

6. A method according to claim 1, wherein said
35 measurement data unit is a control message of one of an

Internet Control Message Protocol (**ICMP**), a Real-Time Control Protocol (**RTCP**), Asynchronous Transfer Mode (**ATM**) Operation And Maintenance (**OAM**) messages, and a proprietary signaling procedure.

5

7. A method according to claim 6, wherein, if said Internet Control Message Protocol (**ICMP**) is applied, a round-trip delay estimation is calculated by means of the corresponding echo request and echo reply messages, and
10 said delay calculation device calls this application, in parallel to which voice data is transferred within User Datagram Protocol (**UDP**) packets and Internet Protocol (**IP**) packets, respectively.

15 8. A method according to claim 6, wherein, if said Real-Time Control Protocol (**RTCP**) is applied, a round-trip delay estimation is calculated by means of sender and receiver reports of said Real-Time Control Protocol (**RTCP**), and said delay calculation device calls this
20 application, in parallel to which voice data is transferred within User Datagram Protocol (**UDP**) packets, Internet Protocol (**IP**) packets and Real-Time Protocol (**RTP**) packets, respectively.

25

9. A method according to claim 2, wherein said delay calculation device (**15**) monitors a call signaling device (**17**) and said delay information request is triggered when
30 a call is established by a call setup signaling of said call signaling device (**17**).

10. A method according to claim 9, wherein said delay request is triggered (**S53**) during the signaling of a call establishment after a voice channel is activated (**S52**)

and a delay is replied (S54) before an alerting is signaled.

11. A method according to claim 10, wherein after said
5 delay information is replied (S54), said delay
calculation is performed (S55), and said shift register
(14) is adjusted (S56), it is checked (S57) whether an
echo path model being present in said delay calculation
device (15) is reliable, and if not, said echo removing
10 device (18) calls an echo request procedure (S53, S54,
S55, S56) again.

12. A method according to claim 11, wherein after said
checking (S57) of reliability, it is checked (S58)
15 whether said call is released, and if not, said checking
(S57) of reliability is repeated.

13. A communication network system comprising
a Switched Circuit Network (SCN),
20 a Packet Data Network (PDN),
a gateway apparatus (GW) of said Switched Circuit
Network (SCN) on the interface to the Packet Data Network
(PDN), wherein said gateway (GW) apparatus comprises
means (15, 16) for providing delay information of an echo
25 path of a speech connection from said Switched Circuit
Network (SCN) to said Packet Data Network (PDN) by using
control messages of said Packet Data Network (PDN), and
a gateway apparatus of said Packet Data Network
(PDN) on the interface to the Switched Circuit Network
30 (SCN) which supports the functions of said gateway
apparatus of said Switched Circuit Network (SCN).

14. A system according to claim 13, wherein said control
messages are of one of an Internet Control Message
35 Protocol (ICMP), a Real Time Control Protocol (RTCP),

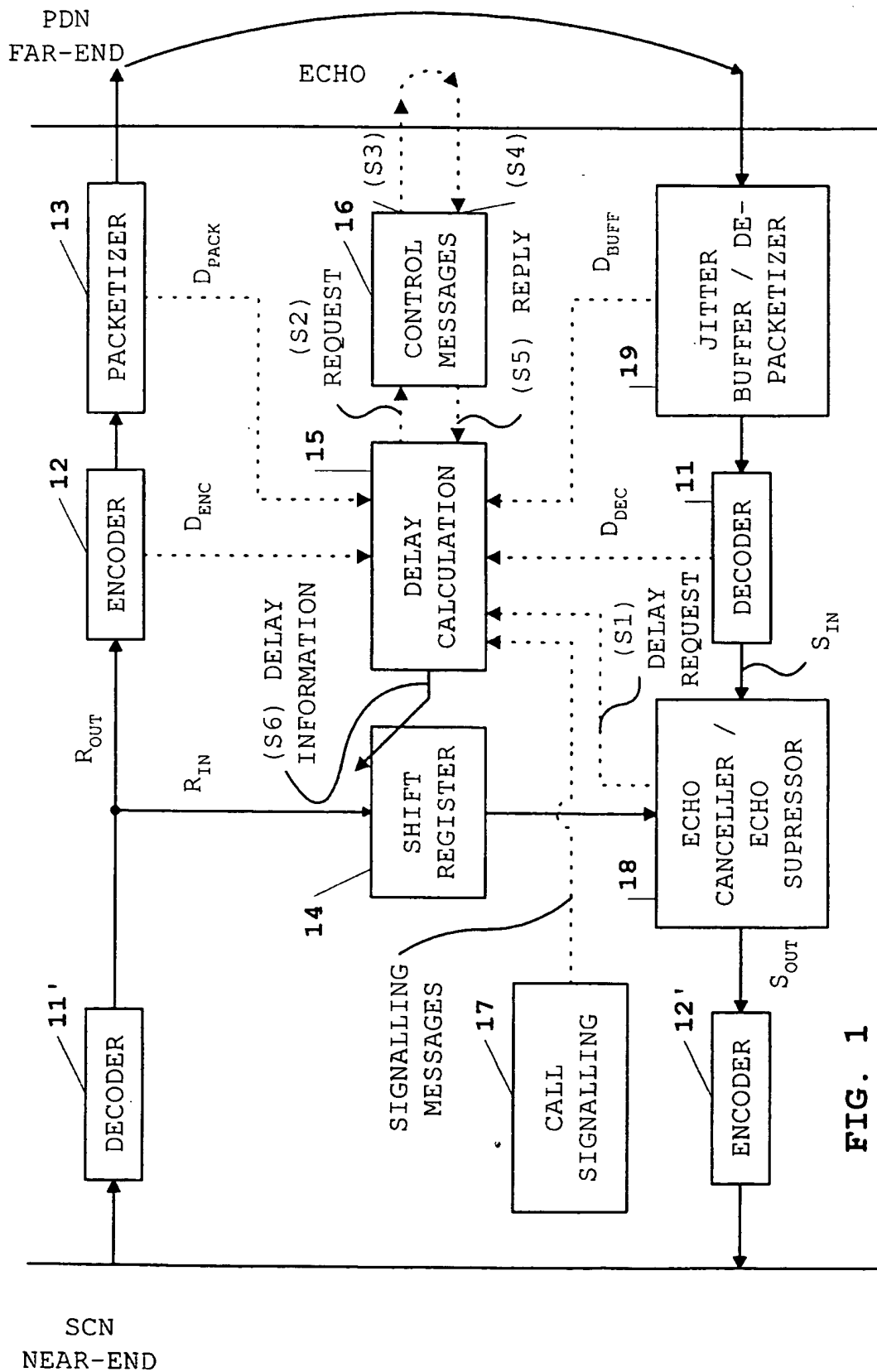
Asynchronous Transfer Mode **(ATM)** Operation And Maintenance **(OAM)** messages, and a proprietary signaling procedure.

- 5 15. A system according to claim 13, wherein said gateway apparatus **(GW)** further comprises means **(14, 18)** for removing echo from said speech connection by using said provided delay information.
- 10 16. A gateway apparatus comprising
means **(11, 11', 12, 12', 13, 19)** for providing an interface functionality between a Switched Circuit Network **(SCN)** and a Packet Data Network **(PDN)**;
echo estimation means **(16)** for providing delay
15 information of the echo of a speech connection;
a delay calculation device **(15)** for calculating an estimation of a total round-trip delay of an echo path of said speech connection;
a shift register **(14)** getting an adjustment input
20 from said delay calculation device **(15)**; and
an echo removing device **(18)**, the performance of which is optimized in view of its echo removing capability by a respective input of said shift register **(14)**.
- 25 17. A gateway apparatus according to claim 16, wherein said echo estimation means **(16)** is capable of sending control messages.
- 30 18. A gateway apparatus according to claim 16, wherein said echo removing device **(18)** is an echo canceller and comprises an adaptive filter, the range of which is hit by the returning echo by said shift register **(14)** being adjusted appropriately.

19. A gateway apparatus according to claim 16, wherein
said echo removing device (18) is an echo suppressor and
comprises a switching function, the timing of which is
appropriate for a round-trip delay of said speech
5 connection by said shift register (14) being adjusted
appropriately.

20. A gateway apparatus according to claim 16, further
comprising
10 a call signaling device (17) for signaling during
call establishment and call transaction of calls via said
gateway apparatus, wherein said delay calculation device
(15) monitors said call signaling device (17).

1/6



2/6

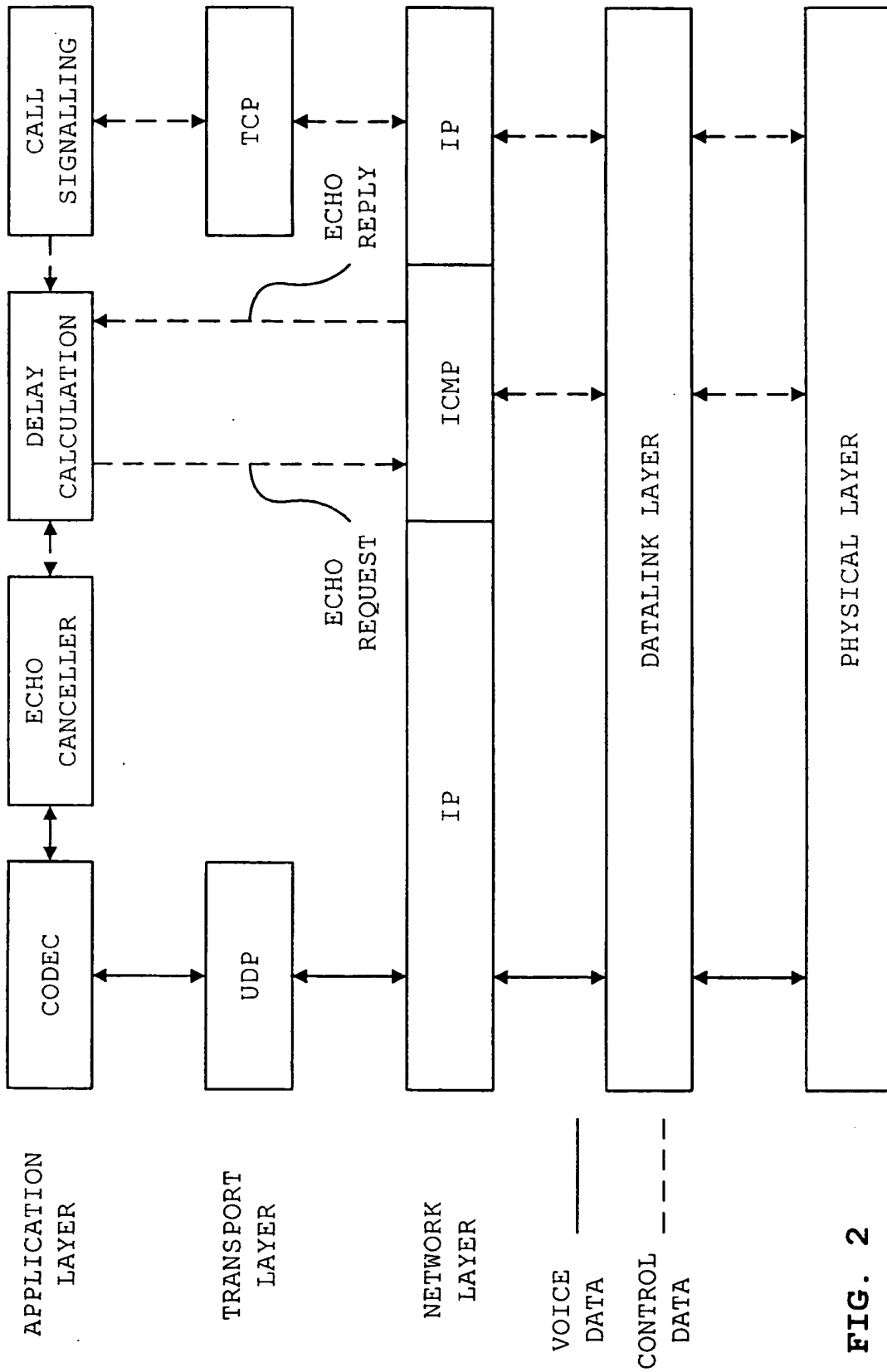


FIG. 2

3/6

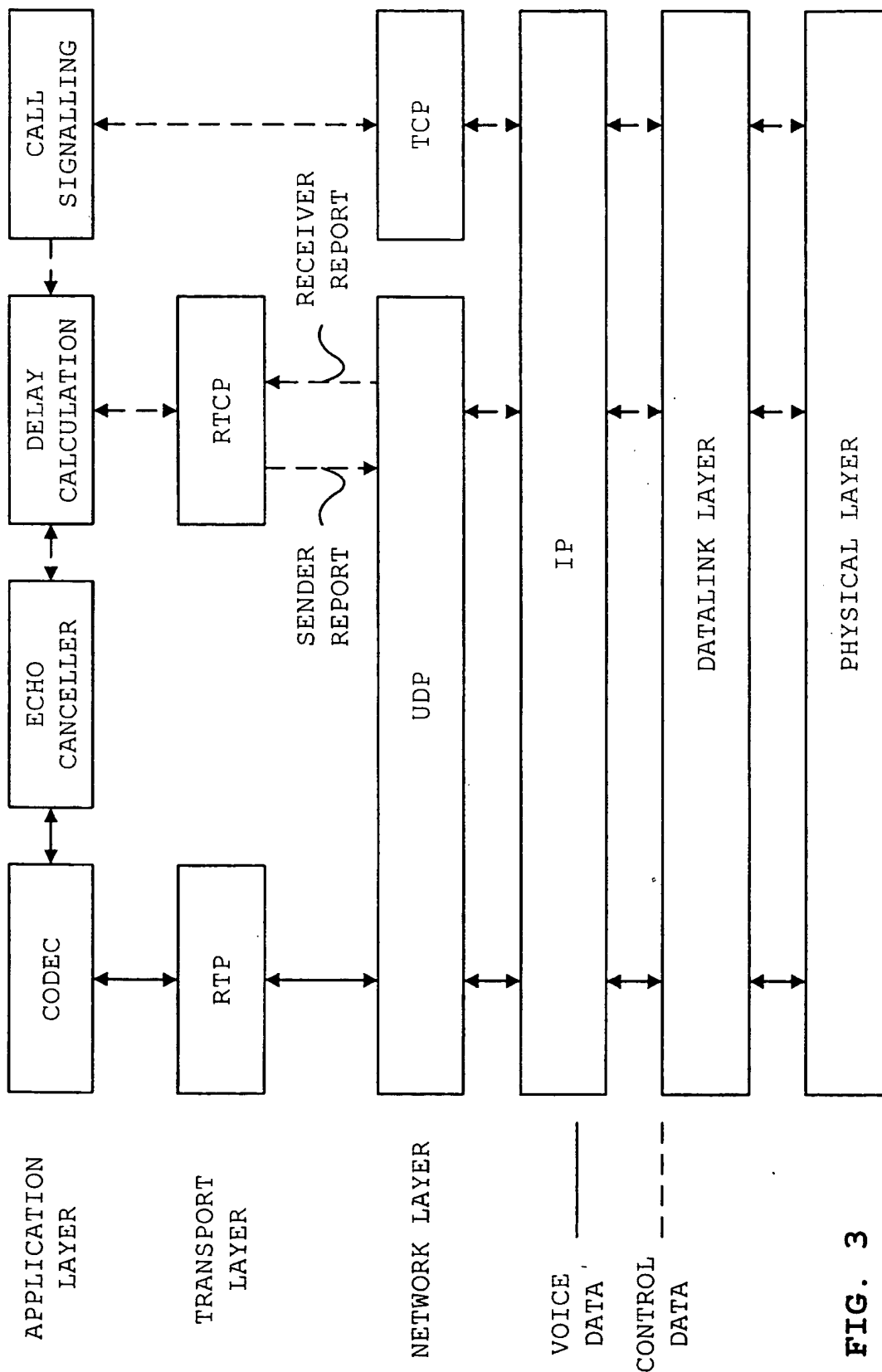


FIG. 3

4/6

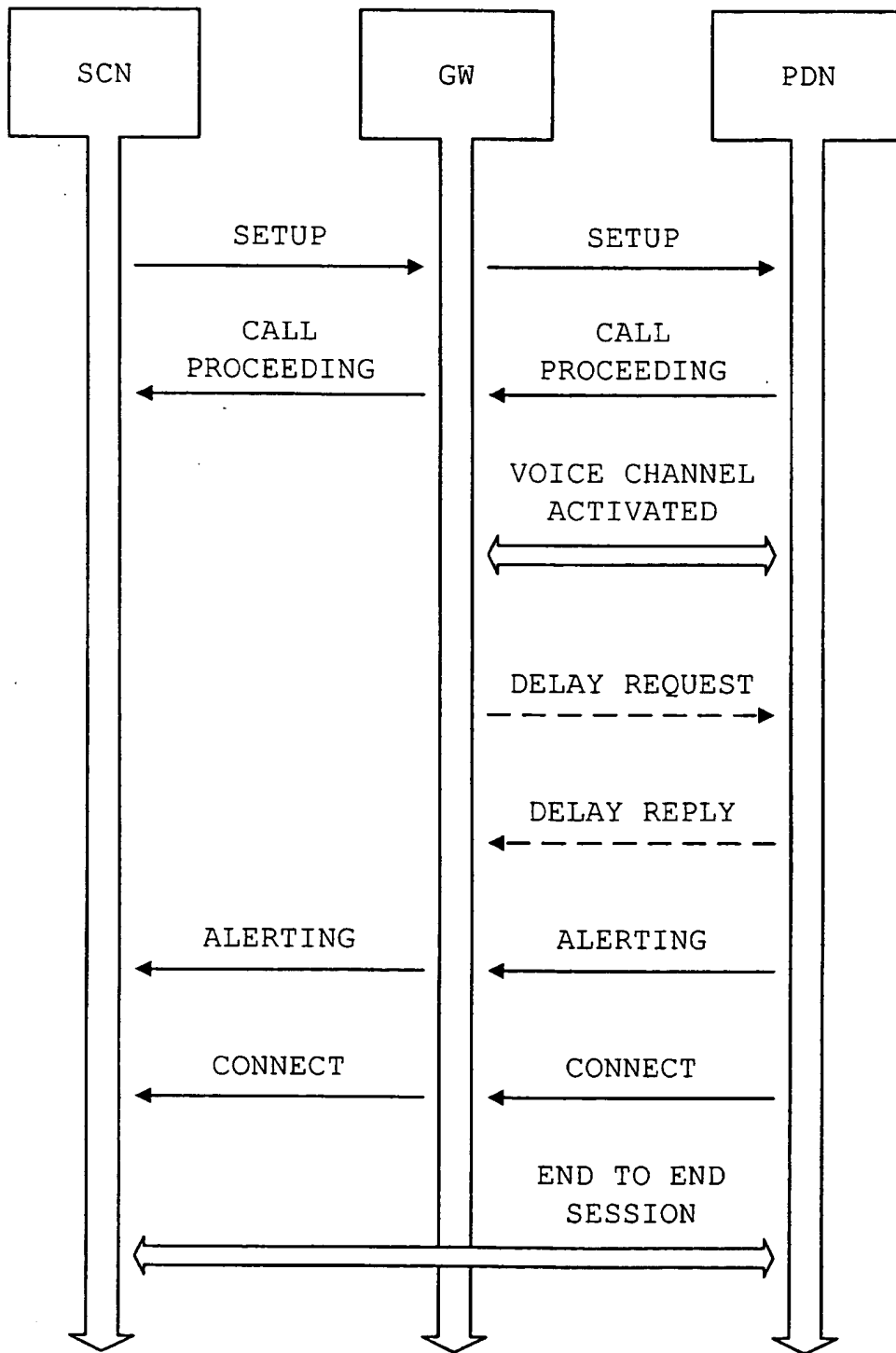


FIG. 4

5/6

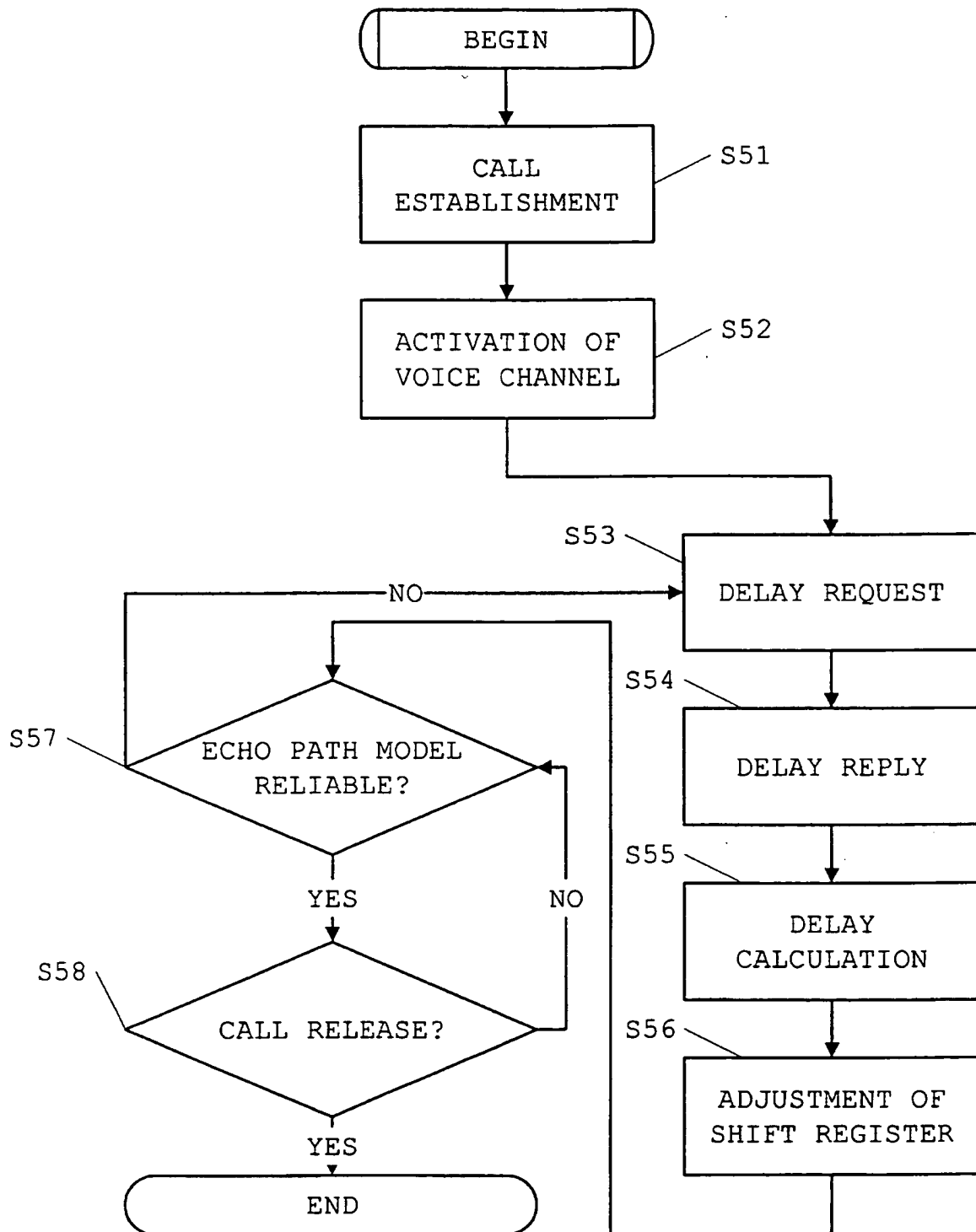


FIG. 5

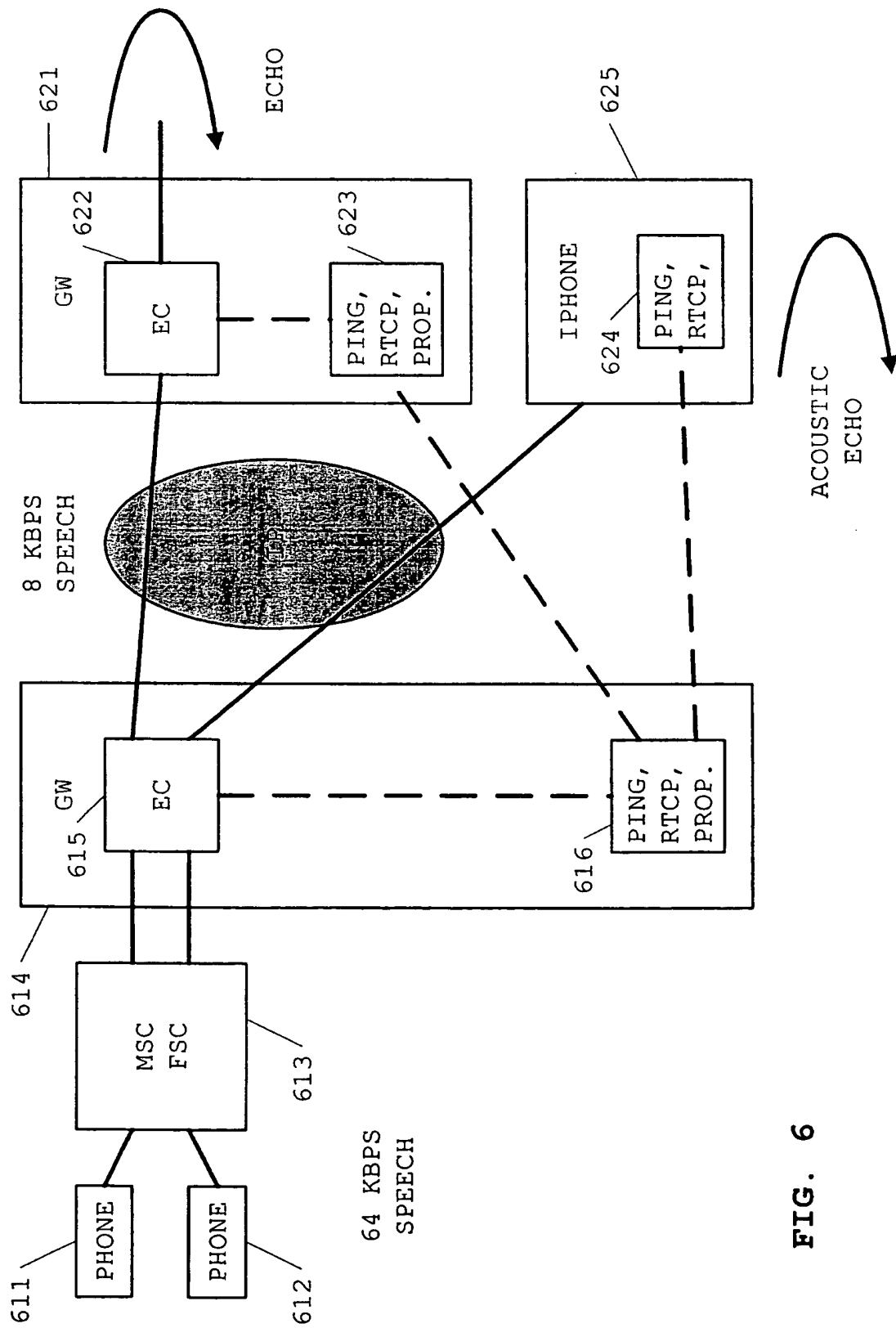


FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/10096

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B3/23 H04L12/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 00 25487 A (GRAF LESLIE ;RYTINA IAN (AU); GROVES CHRISTIAN (AU); ERICSSON TELE) 4 May 2000 (2000-05-04) abstract page 2, line 12 -page 3, line 17 page 5, line 18 - line 26 page 6, line 15 -page 7, line 18; figure 1 claims 1-4	1,2,9, 13-16
A	US 5 477 531 A (PHAAL PETER ET AL) 19 December 1995 (1995-12-19) abstract column 1, line 10 - line 56	1-20
A	EP 0 895 397 A (BITWAVE PTE LTD) 3 February 1999 (1999-02-03) page 2, line 54 -page 3, line 17 page 4, line 33 - line 50; figures 2,3	1,4,13, 16,18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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